Topic 3: Movement into and out of Cells

3.1 Diffusion

Definition: Diffusion is the **net movement of particles** from a region of **higher concentration** to a region of **lower concentration** (down a concentration gradient), as a result of their random movement.

- **Energy Source:** The energy for diffusion comes from the **kinetic energy** of the randomly moving molecules and ions.
- **Cell Membrane:** Some substances move into and out of cells by diffusion through the **cell membrane**.
- **Importance:** Diffusion is important for the movement of gases (e.g., oxygen into cells, carbon dioxide out of cells) and solutes (e.g., dissolved food molecules) in living organisms.
- **Factors Influencing Diffusion:**
    - **Surface Area:** Larger surface area increases the rate.
    - **Temperature:** Higher temperature increases the rate (higher kinetic energy).
    - **Concentration Gradient:** Steeper gradient increases the rate.
    - **Distance:** Shorter distance (thinner membrane) increases the rate.

3.2 Osmosis

Water as a Solvent

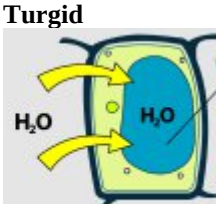
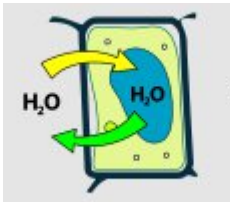
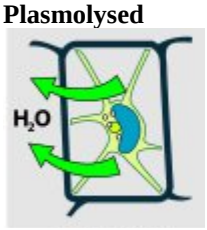
Water is the universal solvent in organisms, essential for:

- **Solvent:** Hydrolysing large molecules.
- **Excretion:** Dissolving and transporting waste products.
- **Transport:** Making up the bulk of blood plasma and plant xylem/phloem.

Definition

- **Osmosis** is the **net movement of water molecules** from a region of **higher water potential** (dilute solution) to a region of **lower water potential** (concentrated solution), through a **partially permeable membrane**.
- Water moves into and out of cells by osmosis through the **cell membrane**.

Effects of Osmosis on Plant Cells (Phases)

External Solution	Water Movement	Cell Condition	Term	Supporting Feature
Dilute (Higher Water Potential)	Water moves **into** the cell.	Vacuole swells, cytoplasm pushes against the cell wall.	**Turgid** 	Cell wall prevents bursting.
Isotonic (Equal Water Potential)	No net movement of water.	Cell contents are not pressed against the cell wall.	**Flaccid** 	Cell wall remains rigid, but cell is limp.
Concentrated (Lower Water Potential)	Water moves **out of** the cell.	Vacuole shrinks, cell membrane pulls away from the cell wall.	**Plasmolysed** 	Cell wall remains rigid, but cell contents shrink.

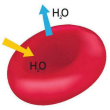
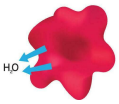
- **Turgor Pressure:** The pressure of water inside the cell pressing outwards on the cell wall. This pressure provides **support** for non-woody parts of the plant (e.g., leaves and stems).

Detailed Explanation of Plant Cell Conditions

- **Turgid:** Occurs in a dilute solution. Water moves into the cell, causing the vacuole to swell and the cytoplasm to press firmly against the cell wall. This is the normal, healthy state for a plant cell, providing maximum support.
- **Flaccid:** Occurs in an isotonic solution (or after slight water loss). The cell is limp because there is no turgor pressure. The cell membrane is still in contact with the cell wall, but the cell is soft.
- **Plasmolysed:** Occurs in a concentrated solution. Water leaves the cell by osmosis, causing the cytoplasm and vacuole to shrink dramatically. The cell membrane pulls away from the rigid cell wall. This is a severe condition that causes the plant to wilt.

Effects of Osmosis on Animal Cells (Phases)

Animal cells (e.g., Red Blood Cells) do not have a cell wall, making them vulnerable to water potential changes.

External Solution	Water Movement	Cell Condition	Result
Dilute/Hypotonic (Higher Water Potential)	Water moves **into** the cell.	Cell swells and bursts.	**Lysis** 
Isotonic (Equal Water Potential)	No net movement of water.	Cell contents are not pressed against the cell membrane.	**Flaccid** 
Concentrated/Hypertonic (Lower Water Potential)	Water moves **out of** the cell.	Cell shrinks and becomes crinkled.	**Crenaton** 

Importance of Osmosis

Osmosis is important for the uptake and loss of water by organisms, e.g., water uptake by plant root hairs and maintaining the correct water balance in animal cells.

3.3 Active Transport

Definition: Active transport is the **movement of particles** through a cell membrane from a region of **lower concentration** to a region of **higher concentration** (**against** a concentration gradient), using **energy from respiration**.

- **Mechanism: Protein carriers**, which change shape to move **specific** molecules or ions across the membrane, are used in active transport. move molecules or ions across a membrane during active transport .
- **Importance:** Active transport is essential for the movement of molecules or ions across membranes, such as the **uptake of ions by root hair cells** in plants.
- **Energy Requirement:** Since movement is against the concentration gradient, it requires **energy (ATP)** supplied by respiration.